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# Television Cinemaphotography of Auroras and Preliminary Measurements of Auroral Velocities

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During October 1963 a series of tests were performed at Fort Churchill, Manitoba, on the usefulness of an image orthicon closed-circuit television system for indirect auroral photography. The system used was similar to one described in a paper by *Hicks* [1963]. It was equipped with an f/0.75 lens providing an effective field of view of 16°. Recording was accomplished by photographing the television monitor with a 16-mm cinema camera.

Operated at maximum sensitivity, the system allowed direct viewing of 8th and 9th magnitude stars on the television monitor. At this sensitivity level, the system was somewhat better than the unaided, dark-adapted human eye in the detection of weak auroral structures. No difficulty was found in obtaining auroral photographs of even the weakest structures with exposures of 1/60 sec at the normal sound cinema rate of 24 frames per second. For brighter forms it was necessary to electronically reduce the system sensitivity. Examples of some of the photographs are presented in Figure 1.

Most of the photographs were recorded on Eastman Plus-X black and white film. In addition, color photographs on Eastman High-Speed Ektachrome film were obtained by sequential insertion of broad-band color filters into the optical system. A color cycle consisting of the placement of red, green, and blue filters into the system was completed in 1/8 sec. The result was a cinema film strip showing a frame with red image, then a frame with green image, and finally a frame with blue image; the cycle was then repeated. Projected at normal sound speed, the color film shows much flicker but the eye integrates sufficiently so that the colors are additive. Since the spectral response of the system is broader in wavelength than the eye, the color films show more red (due to O I λ 6300–6364 and $N_2$ first positive bands) and blue (due mainly to $N_2^+$ first negative bands near λ 4278 and λ 4652) than one normally sees by direct visual observation. The filters used in the preliminary tests are very wide, near 800 A at half-peak transmission. In the future much narrower filters will be used in order to isolate specific auroral emissions.

Both the color and black and white television cinema-photography techniques provide data for the study of a variety of morphological aspects of auroral structures. These aspects include auroral motions, auroral pulsations, and the growth, decay, and configurations of individual structures. The technique may allow the examination of the relative spatial distributions of the principal auroral emissions in more detail than has been possible previously.

Preliminary analysis of the data has been aimed at the measurement of apparent horizontal velocities with emphasis on the faster

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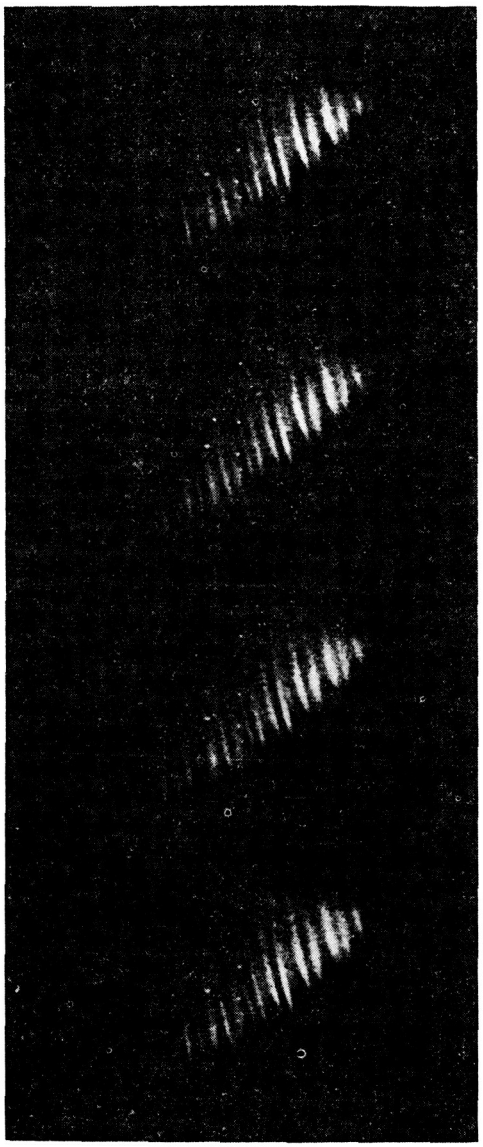

Fig. 1. From top to bottom, four consecutive photographs of a rayed arc with evenly spaced and relatively stable ray structures. The exposure of each photograph is 1/60 sec; the interval between adjacent photographs is 1/24 sec. The spacing between the ray structures is near 1.8 km. Note the subtle temporal changes in the aurora that are evident by comparing adjacent photographs.

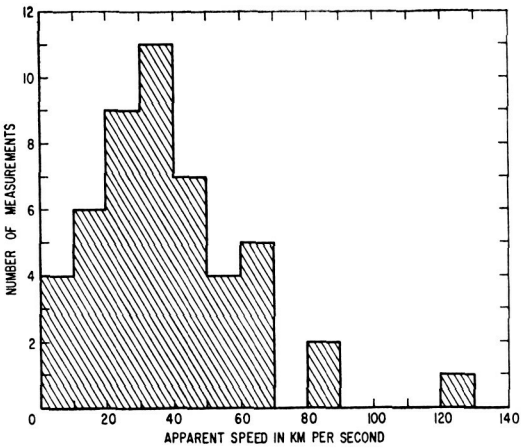


Fig. 2. Range of 49 measurements of horizontal speeds of auroral rays and regions of enhanced luminosity. The speed spectrum between 0 and 130 km/sec is divided into 13 equal blocks, and the number of measurements falling within each block is shown.

motions. These fast motions are of folds within auroral structures, of ray bundles, or of well-defined regions of enhanced luminosity (streaming). In some cases it is not clear which type of motion is being observed. A summary of 49 velocity measurements is presented in Figure 2. The values presented there are obtained by assuming an auroral lower border height of 100 km. This assumption and the limited precision of angular calibration of the television system as used in October 1963 lead to uncertainties in the velocity magnitudes which are estimated at 10 per cent. The measurements were performed on moving structures visible on consecutive film frames ranging in number from 6 to 125 (duration 0.2 to 5 sec).

## Reference

Hicks, G. T., Image orthicon techniques and satellite cinemaphotography, Anna 1-B, *Photographic Sci. Eng.*, *7*, 328–330, 1963.

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